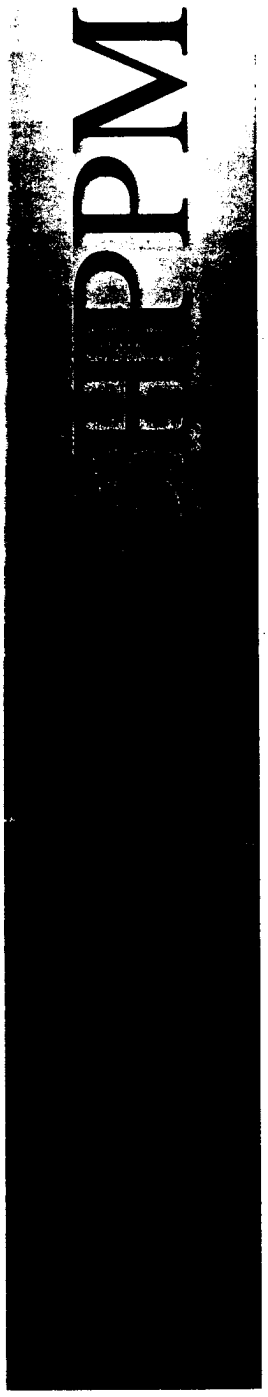

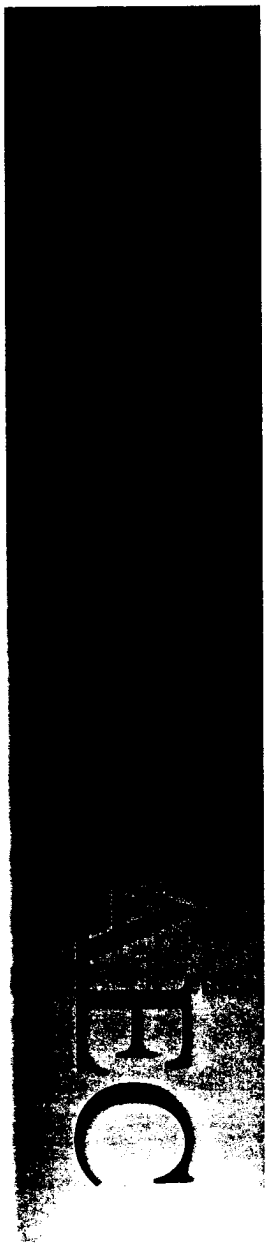

GUIDANCE FOR CONFORMING TO THE REQUIREMENTS OF THE INTERIM ENHANCED SURFACE WATER TREATMENT RULE AND THE DISINFECTANT/DISINFECTION BYPRODUCTS RULE

WATER SUPPLY MANAGEMENT INFORMATION PAPER
NO. IP-31-024

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U.S. Army Center for Health Promotion and Preventive Medicine
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John Brokaw

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
USACHPPM, Water Supply Management Program
5158 Blackhawk Road
Aberdeen Proving Ground, MD 21010-5422

USAEC, Attn.: SFIM-AEC-EQC
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U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

GUIDANCE FOR CONFORMING TO THE REQUIREMENTS OF THE INTERIM ENHANCED SURFACE WATER TREATMENT RULE AND THE DISINFECTANT/DISINFECTION BY-PRODUCTS RULE

WATER SUPPLY MANAGEMENT INFORMATION PAPER NO. IP-31-024

EXECUTIVE SUMMARY

This information paper provides guidance to address the recently promulgated Interim Enhanced Surface Water Treatment Rule (IESWTR) and the Stage 1 Disinfectant/Disinfection Byproduct (D/DBP) Rule. The two rules are intended to reduce health threats from both microbial pathogens and disinfectants and byproducts formed during the disinfection process. These rules are complex. Future rules will be even more restrictive.

The IESWTR applies to public water systems using surface water supplies, including ground water under the direct influence of surface water, and serving 10,000 or more customers. The D/DBP Rule will apply to all public systems that apply a chemical disinfectant. Implementation dates for the rules begin December 2001 or later and vary according to the size of the water system. The IESWTR contains a requirement to assess the status of current disinfection byproducts that must begin by June 1999 and extends into 2000. A limited number of Army installations may have to conduct associated monitoring to determine their status.

The Army has many water systems that will ultimately be affected by these regulations. Installations within the continental United States (CONUS) should proceed according to primacy State directives. Installations outside CONUS will have to comply as IESWTR and D/DBP requirements are incorporated into overseas final governing standards. Actions that Army water suppliers may need to take to prepare for implementation are discussed.

This information paper has been prepared under a partnership project between the U.S. Army Center for Health Promotion and Preventive Medicine, Water Supply Management Program, and the U.S. Army Environmental Center, Environmental Compliance Division. The author wishes to thank staff members who contributed to the development of this document.

Readiness thru Health

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5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

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1. REFERENCES. Appendix A contains a complete list of references.

2. PURPOSE. This information paper provides guidance to address the recently promulgated Interim Enhanced Surface Water Treatment Rule (IESWTR) and the Stage 1 Disinfectant/Disinfection Byproduct (D/DBP) Rule. Actions that Army water suppliers may need to take are also discussed.

3. DEFINITIONS. The IESWTR and the Stage 1 D/DBP Rule contain numerous terms that may be unfamiliar or are unique to the new rules. Definitions are provided in Appendix B.

4. BACKGROUND.

a. REGULATORY FRAMEWORK. The 1974 Safe Drinking Water Act (SDWA) was passed by Congress in order to ensure safe drinking water supplies in the United States. The nation's drinking water supplies are regulated with respect to contaminants impacting health by the National Primary Drinking Water Regulations (NPDWR) (reference 1). Congress passed amendments to the SDWA in 1986 and 1996. The U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) Technical Guide 179 (reference 2), published in 1995, describes the NPDWR as it applied to Army installations up to that time. The 1996 amendments required the U.S. Environmental Protection Agency (EPA) to further regulate certain microbial contaminants and disinfection byproducts (reference 3). As a result, the IESWTR and the Stage 1 D/DBP Rule were finalized and promulgated on 16 December 1998, each with an effective date of 16 February 1999 (references 4 and 5). These new rules are a product of 6 years of collaboration between the water industry, environmental and public health groups, and local, state and Federal government. These and associated future rules are also referred to as the Microbial and Disinfection Byproduct (M-DBP) Rules (reference 6).

b. DRINKING WATER AND HEALTH CONCERNS.

(1) The vast majority of Americans drink tap water that meets all existing health standards. These new rules will further strengthen existing drinking water standards and thus increase protection for many water systems. The EPA's Science Advisory Board concluded in 1990 that

exposure to microbial contaminants such as bacteria, viruses, and protozoa (e.g., *Giardia lamblia* and *Cryptosporidium*) was likely the greatest remaining health risk management challenge for drinking water suppliers (reference 6). Acute health effects from exposure to microbial pathogens are documented. Associated illness can range from mild to moderate cases lasting only a few days to more severe infections that can last several weeks and may result in death for those with weakened immune systems. Most waterborne illnesses are gastrointestinal in nature and include nausea and diarrhea as symptoms.

(2) Disinfection, primarily by chlorination, has unquestionably, significantly reduced the number and extent of waterborne illness during the last 50 years. However, while disinfectants are effective in controlling many microorganisms, health information obtained during the last 2 decades has helped regulators recognize that the disinfectants and resulting by-products may themselves impact human health. Disinfectants react with natural organic and inorganic matter in source water and distribution systems to form the disinfection byproducts (DBPs). Many of these DBPs have been shown to cause cancer and reproductive and developmental effects in laboratory animals (reference 5). The human health effects are less well known and studies continue. For example, the contaminants known collectively as total trihalomethanes (TTHM) have been recognized as DBPs. Large water systems serving ≥ 10,000 have had a TTHM regulatory requirment for years under the NPDWR. Now other DBPs have been identified as well. More than 200 million people consume water that has been disinfected. Because of the large population exposed, health risks associated with DBPs, even if small, need to be taken seriously.

(3) A major challenge for water suppliers is how to balance the risks from microbial pathogens and the DBPs. It is important to provide protection from these microbial pathogens while simultaneously ensuring decreasing health risks to the population from the chemical disinfectants. This fact sheet contains general information about the two new rules and others that are a part of the M-DBP Rules.

(4) *Cryptosporidium* – A Special Challenge. Some microbial pathogens, such as *Cryptosporidium*, have proven resistant to traditional disinfection practices. *Cryptosporidum* is a protozoan microbe carried in the gut of numerous animal species, most notably young cattle. The organism is shed in fecal material and ultimately can be found in nearly all surface water supplies (reference 7). In the environment, the organism exists in a protective shell called an oocyst. When ingested by humans the *Cryptosporidium* can cause a severe diarrheal illness. In 1993, *Cryptosporidium* caused 400,000 people in Milwaukee to experience intestinal illness. More than 4,000 were hospitalized, and at least 50 deaths have been attributed to that event (reference 6). Although there are no effective drugs to treat the illness, persons with competent immune systems normally recover in less than 2 weeks. There have also been cryptosporidiosis outbreaks in Nevada, Oregon, and Georgia over the past several years. Disinfection of *Cryptosporidium* using chlorine is completely ineffective (reference 4). Therefore, it is critical that the other treatment processes operate optimally to eliminate the *Crytposporidium* presence. Ensuring this optimal treatment against *Cryptosporidium* is at the heart of the IESWTR.

c. RELATED REGULATIONS. The NPDWR already contain a number of regulations to address microbial and DBP concerns. These existing regulations are in the 40 Code of Federal Regulations (CFR), Part 141, NPDWR.

(1) The Surface Water Treatment Rule (SWTR), promulgated in 1989, applies to all public water systems (PWS) using surface water sources or ground water under the direct influence of surface water (GWUDI) (reference 8). It established maximum contaminant level goals (MCLGs) for viruses, bacteria and the protozoan *Giardia lamblia*. It also includes treatment technique requirements for filtered and unfiltered systems that are specifically designed to protect against the adverse health effects of exposure to these microbial pathogens. Included in the treatment technique requirements are filtered water turbidity standards and disinfection standards. Conventional water treatment facilities, for example, must achieve finished water turbidity removals to $\leq$ 0.5 NTU in 95 percent of measurements. The disinfectant "CT" concept (residual disinfectant concentration X contact time) was applied. Using the combination of filtration and disinfection, water systems had to demonstrate 3 log (99.9 percent) removal of *Giardia lamblia* and 4 log (99.99 percent) removal of viruses.

(2) The Total Coliform Rule, revised in 1989, applies to all PWS and established a maximum contaminant level (MCL) for total coliforms (reference 9). The total coliform bacteria group is used as the primary indicator of the microbial quality of drinking water. Water systems cannot exceed a level of 5 percent of monthly samples containing total coliforms. The rule also implemented a requirement that total coliform-positive samples must be analyzed for either fecal coliforms or *E. coli* in order to better determine true health significance of the total coliform presence.

(3) Disinfection By-Products: In 1979, the EPA set an interim MCL for TTHM of 0.10 mg/l (100 ppb) as an annual average (reference 10). This applies to any community water system serving at least 10,000 people that adds a disinfectant to the drinking water during any part of the treatment process.

(4) Information Collection Rule. To support the M-DBP rulemaking process, the Information Collection Rule (ICR) established monitoring and data reporting requirements for large public water systems serving at least 100,000 people (reference 11). This rule was intended to provide the EPA with information on the occurrence in drinking water of microbial pathogens and DBPs. In addition, as part of the ICR, the EPA is collecting engineering data on how PWSs currently control such contaminants. Of the regulations outlined in this section, the ICR did not apply to Army systems because Army systems did not meet minimum population requirements.

d. DEVELOPMENT AND PROMULGATION OF THE M-DBP RULES. The final IESWTR and D/DBP rules resulted from formal regulatory negotiations with a wide range of stakeholders that took place in 1992-93 and 1997. The Federal Advisory Committee Act (FACA) provided the basis to establish the M-DBP committee that consisted of Federal and state regulators, health experts and water facility representatives. The EPA finalized the IESWTR and Stage 1 D/DBP in November 1998, as required by the 1996 Amendments to the Safe Drinking Water Act, Section 1412(b)(2)(C). The two rules were subsequently promulgated on 16 December 1998 (references 4 and 5).

e. APPLICATION TO ARMY FACILITIES.

(1) Continental United States (CONUS). The M-DBP rules will apply, to some degree, to all Army installations classified as a PWS. Requirements of the D/DBP are likely to have the most initial impact because of the Army requirements to disinfect water supplies. Currently, most Army PWS in the United States use chlorine as their disinfectant. Some Army systems employ chloramine. A very limited number may use chlorine dioxide. The M-DBP requirements affecting water systems using surface water/GWUDI sources will be phased-in according to system size.

(2) Outside CONUS (OCONUS). The IESWTR and D/DBP Rule requirements are expected to apply to OCONUS Army facilities in the future. Currently, requirements for OCONUS water systems are generally contained in final governing standards (FGS). In most cases the FGS are based on the guidelines contained in the 1992 Overseas Environmental Baseline Guidance Document (OEBGD) (reference 12). As an example, the current OEBGD states that surface water supplies, including GWUDI, must meet treatment requirements which are based on the SWTR. A new OEBGD has been drafted and is expected to be finalized during 1999 (reference 13). Requirements of the IESWTR and the D/DBP will not appear in the 1999 version. However, future updates to the OEBGD can be expected to incorporate the more stringent IESWTR and D/DBP requirements, which in turn would be used to develop new FGS.

5. INTERIM ENHANCED SURFACE WATER TREATMENT RULE.

a. GENERAL. A priority in developing the IESWTR was to provide a way to regulate *Cryptosporidium* in a manner similar to that of *Giardia lamblia* and viruses, i.e., through a treatment technique. The IESWTR, with tightened turbidity performance criteria and required individual filter monitoring, is designed to optimize treatment reliability and to enhance physical removal efficiencies to minimize the *Cryptosporidium* levels in finished water (reference 14). In addition, the rule includes disinfection benchmark provisions to assure continued levels of microbial protection while facilities take the necessary steps to comply with new DBP standards. The rule builds upon the treatment technique requirements of the SWTR with the following key additions and modifications:

- An MCLG of zero for *Cryptosporidium*
- 2-log (99 percent) *Cryptosporidium* removal requirements for systems that filter
- Strengthened combined filter effluent turbidity performance standards
- Individual filter turbidity monitoring provisions
- Disinfection profiling and benchmarking provisions
- Systems using ground water under the direct influence of surface water now subject to the new rules dealing with *Cryptosporidium*
- Inclusion of *Cryptosporidium* in the watershed control requirements for unfiltered public water systems
- Requirements for covers on new finished water reservoirs
- Sanitary surveys, conducted by states, for all surface water systems regardless of size

b. AFFECTED WATER SYSTEMS. The IESWTR applies to those PWS using surface water, or GWUDI source water, that serve 10,000 or more persons. The rule also includes

provisions for States to conduct sanitary surveys for surface water systems regardless of system size.

c. COMPLIANCE TIMELINES. Most requirements of the IESWTR, for example tightened turbidity monitoring, are not effective until December 2001. However, one requirement must be acted upon immediately for affected water systems. As part of the disinfectant profiling process, explained below, certain PWS must compile 1 year of monitoring data, in the form of quarterly sample sets, for the DBP groups TTHM and haloacetic acids (HAA5). Haloacetic acids are also formed upon reaction of organics with chlorine.

d. CRYPTOSPORIDIUM MCLG. The MCLG is an unenforceable guideline that is established as the treatment goal to ensure protection of health. Previously, MCLGs have been set for those contaminants where monitoring to demonstrate presence or absence is not technically achievable or practical for PWS to implement. The SWTR contains MCLGs of zero for Giardia and viruses. Similarly the IESWTR sets the *Cryptosporidium* MCLG at zero. Although *Cryptosporidium parvum* is the only species presently known to cause illness in humans, the MCLG is listed for the entire *Cryptosporidium* genus, i.e., all species. This approach follows the guidance for setting MCLGs that have an adequate margin of safety.

e. REMOVAL OF *CRYPTOSPORIDIUM* THROUGH FILTRATION. The IESWTR adds *Cryptosporidium* to the list of microbes regulated under the SWTR, including *Giardia lamblia*, viruses and *Legionella* and the associated turbidity. The SWTR uses a combination of filtration and disinfection to achieve levels of microorganism removal. Because *Cryptosporidium* is so resistant to chlorine disinfection, the treatment technique has been set at a 2 log removal achieved through proper filtration. In other terms, a PWS must be capable of removing 99 percent of *Cryptosporidium* oocysts during treatment. Systems using filtration must ensure that the removal occurs at or prior to the first customer and is not subject to re-contamination with surface water runoff. The new *Cryptosporidium* filtration requirements apply to surface water and GWUDI systems (≥10,000) currently filtering for SWTR compliance.

f. FILTERED WATER TURBIDITY MONITORING.

(1) Turbidity has been used historically as a measure of the filter performance. The SWTR set performance criteria for conventional and direct filtration sytems of achieving filtered water turbidity ≤ 0.5 Nephelometric Turbidity Unit (NTU) in at least 95 percent of measurements during the month. Currently, a system exceeding 5 NTU for any measurement would violate the treatment technique criteria as well. These measurements are taken at the combined filter effluent. The IESWTR will require even more stringent turbidity control for conventional/direct filtration systems of ≤ 0.3 NTU in at least 95 percent of monthly samples and the maximum allowable turbidity will be 1 NTU for combined filtered water. The turbidity performance standards for slow sand and diatomaceous earth systems remain the same as required by the SWTR, at 95 percent monthly measurements ≤ 1 NTU and a maximum turbidity of 5 NTU in any measurement.

(2) A new requirement of the IESWTR is that continuous turbidity monitoring must now be performed on individual filters in a treatment train. This requirement is not part of the

treatment technique but is intended to help water systems identify poorly performing filters and make needed adjustments. Conventional or direct filtration systems must use calibrated turbidimeters to continually record individual filter turbidities every 15 minutes. Monitoring the individual filters applies only to conventional and direct filtration systems.

(3) Four conditions have been identified where the water system will be required to take action to address an unusual turbidity condition that occurs at any of the individual filters. The conditions and required action are described below. Each of the conditions is based on consecutive turbidity measurements 15 minutes apart.

(a) Two consecutive measurements > 1.0 NTU. Record the date, filter number, and measurements. Produce a filter profile within 7 days if no obvious reason for excursion can be identified. Within 10 days, report to the state that the filter profile has been completed or identify reason for excursion.

(b) Two consecutive measurements > 0.5 NTU following 4 hours operation after filter backwashing or being offline. Record the date, filter number, and measurements. Produce a filter profile within 7 days if no obvious reason for excursion can be identified. Report to the state that the filter profile has been completed or identify reason for excursion, within 10 days after end of the month of the occurrence.

(c) Two consecutive measurements > 1.0 NTU in each of 3 consecutive months. Record the date, filter number, and measurements. Assess the filter performance within 14 days. Develop a filter profile identifying performance limiting factors. Prepare a filter self-assessment report.

(d) Two consecutive measurements > 2.0 NTU in 2 consecutive months. Record the date, filter number, and measurements. Arrange for a comprehensive performance evaluation (CPE) within 30 days of excess turbidity measurements. Perform and report CPE findings within 90 days.

g. SYSTEM IMPROVEMENTS THROUGH COMPREHENSIVE PERFORMANCE EVALUATIONS. As described above, individual filter monitoring may identify that filters are not functioning properly resulting in particles including microbes that may pass into the finished water. Conditions may require a CPE be performed. The EPA developed a CPE assessment guideline, or protocol, that provides a thorough performance-based evaluation of a conventional surface water treatment facility process pursuant to the SWTR (references 15, 16)

(1) The CPE protocol includes a detailed statistical evaluation of filtered water turbidities measured at least every 4 hours to assess conformance with the 95/5 percent occurrence criteria. The protocol also includes a detailed evaluation of disinfection efficacy based on application of the CT concept that allows a subsequent determination of actual and required microbial log reductions.

(2) The USACHPPM Water Supply Management Program (WSMP) used the CPE protocol to develop its Water System Performance Evaluation (WSPE) protocol. The WSPE

protocol evaluates an entire waterworks system and has been successfully applied at numerous Army installations. The modular nature of the WSPE allows modification to meet CPE requirements, in order to assist installations with IESWTR compliance issues.

h. DISINFECTION PROFILING AND BENCHMARKING.

(1) The intent of this requirement is to help systems determine if there would be an increased risk from microbial pathogens if disinfection changes are made as a result of Stage 1 D/DBP requirements. Water systems in the IESWTR category must evaluate how disinfection profiling and benchmarking will apply to their system. A three-step approach must be followed – determining if a profile is required, developing the disinfection profile, and calculating the disinfection benchmark (reference 17).

(2) The IESWTR requires that a PWS perform monitoring for the DBP groups TTHM and HAA5. The TTHM group consists of the compounds chloroform, bromodichloromethane, dibromochloromethane,and bromoform. The compounds comprising the HAA5 group are monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid and dibromoacetic acid. The purpose of monitoring the DBPs for a 1-year period is to determine whether the PWS must prepare a disinfection profile. In April 1999, the U.S. Army Environmental Center (USAEC) issued a memorandum to all major Army commands (MACOMs) informing that some Army water systems would need to perform this concurrent DBP monitoring (reference 18).

(3) A disinfection profile will be required if the annual average of the DBPs exceeds 80 percent of the new maximum contaminant levels (MCL) established under the Stage 1 D/DBP rule. The new TTHM MCL is 0.080 mg/L and the HAA5 MCL is 0.060 mg/L. Therefore, the annual averages under this IESWTR monitoring cannot exceed 0.064 mg/L and 0.048 mg/L, respectively. If either level is exceeded a disinfectant profile must be prepared.

(a) The TTHM group has been previously regulated under the NPDWR (reference 10) and pursuant primacy state regulations. A set of samples from the distribution system is analyzed once per quarter. Compliance with the former MCL of 0.10 mg/L was determined on a running annual average of four quarters of data. A number of Army systems have been required to monitor for TTHMs. The 1996 ICR implemented the initial requirement to monitor for HAA5 as well. However, the ICR requirement essentially only applied to surface water systems serving 100,000 and above. No Army systems fell into that category. Now, the IESWTR requires that the HAA5 be monitored and reported in the same manner as the TTHMs.

(b) Monitoring and reporting of data to State authorities must by completed by the end of the month, 15 months after rule promulgation, i.e. by 31 March 2000. A stipulation of the requirement is that monitoring for the TTHMs and HAA5 must occur concurrently within the same period of time.

(c) Some PWS may have already conducted monitoring for both TTHM and HAA5, either under ICR requirements or as recommended by the State to obtain DBP information. Systems that have 1 year of TTHM and HAA5 data from ICR monitoring, must report that data

to their state by December 1999. Because Army systems did not have to fulfill ICR sampling requirements, it is expected that Army water systems would not necessarily have previously performed concurrent TTHM/HAA5 monitoring.

(d) Water systems that have previously monitored for TTHM but have not also monitored for HAA5 during the same interval, must have samples analyzed for HAA5 in addition to TTHM during the next 1-year compliance period. The monitoring must begin during the calendar quarter April – June 1999. Thereafter, collect IESWTR samples at approximately equal 90-day intervals.

(e) As an alternative to conducting 1 year of concurrent TTHM and HAA5 monitoring, a system may elect to forego the monitoring and begin the development of the disinfection profile.

(4) Developing the disinfection profile will be a year long process, whereby the system must determine the adequacy of disinfection against the protozoan *Giardia lamblia*. The water system must determine the total logs of *Giardia* inactivation each day of operation for at least 1 year beginning March 2000. To determine the log inactivation a number of steps must be conducted - determining disinfectant contact time (T) at each residual monitoring point; measuring the residual concentration (C) of the disinfectant before or at the first customer; calculating the total inactivation ratio (CT calc/CT 99.9) before or at first customer.

(5) A system must calculate a disinfection benchmark if it has developed a disinfection profile and then makes a significant change to its disinfection process. Changes to the point of disinfection, the type of disinfectant, or the disinfection process are considered significant and would trigger the benchmarking requirement. The benchmark is calculated by determining the average *G. lamblia* inactivation for each month of each year that disinfection profile data is available. A monthly benchmark value is calculated by dividing the sum of daily *G. lamblia* inactivation logs by the number of values calculated during the month. A PWS with one year of profile data, sets the "benchmark" at the value of the lowest monthly average. If a system has more than one year of profile data, the benchmark is set at the lowest monthly average value for each year of data.

i. SANITARY SURVEYS. Sanitary surveys will be required for community systems every 3 years with the first survey completed by December 2004. The state authorities must conduct the sanitary surveys for water systems. The State may authorize the frequency interval at 5 years for optimal systems. Noncommunity systems must complete a sanitary survey no later than December 2006. As a minimum, the sanitary surveys must address water source, treatment, distribution system, finished water storage, pump facilities, controls, monitoring and reporting of analyses, data verification procedures and overall system management.

j. ADDITIONAL IESWTR REQUIREMENTS. Several less complicated criteria are included in the IESWTR. Unfiltered systems already have stringent water shed protection requirements and those systems must now include *Cryptosporidium* control in their program. *Cryptosporidium* has now been added to the GWUDI definition for water systems ≥ 10,000. Finally, the IESWTR mandates the covering of water storage tanks.

6. STAGE 1 D/DBP RULE REQUIREMENTS.

a. GENERAL.

(1) While disinfectants are effective in controlling many microorganisms, they react with natural organic and inorganic matter in source water and distribution systems to form DBPs. Results from toxicology studies have shown several DBPs (e.g., bromodichloromethane, bromoform, chloroform, dichloroacetic acid, and bromate) to be carcinogenic in laboratory animals. Other DBPs (e.g., chlorite, bromodichloromethane, and certain haloacetic acids) have also been shown to cause adverse reproductive or developmental effects in laboratory animals. Several epidemiology studies have suggested a weak association between certain cancers (e.g., bladder) or reproductive and developmental effects, and exposure to chlorinated surface water.

(2) The anticipated benefits from implementation of the Stage 1 D/DBP are many. The EPA estimates that nearly140 million people will receive increased protection from DBP health impacts. There will be a significant reduction in the national average TTHM levels and as well as reduced exposure to the DBPs formed when ozone and chlorine dioxide are used as the primary water disinfectants (reference 19). Bromate is a DBP formed from ozone, chlorite is formed during chlorine dioxide use. The costs of implementing newly required treatment to reduce the DBPs will be significant. The total cost to implement the Stage 1 D/DBP rule is expected to be approximately $700 million annually. However, EPA estimates that 95 percent of U.S. households will incur additional costs of less than $1 per month on their water bills.

(3) Key Provisions of the Stage 1 Rule. The Stage 1 D/DBP Rule updates and supersedes the 1979 regulations for total TTHM. In addition, it will reduce exposure to three disinfectants and many disinfection byproducts. The rule establishes maximum residual disinfectant level goals (MRDLGs) and maximum residual disinfectant levels (MRDLs) for three chemical disinfectants - chlorine, chloramine, and chlorine dioxide. The terms MRDLG and MRDL were created to distinguish disinfectants, which are beneficial when applied correctly, from drinking water contaminants which are assigned MCLs. The Stage 1 D/DBP also establishes MCLGs and MCLs for TTHMs, HAA5s, chlorite and bromate (see Table 1). Another important provision is the inclusion of a treatment technique for water systems to remove DBP precursor material in order to reduce DBP levels.

b. AFFECTED WATER SYSTEMS. The Stage 1 D/DBP Rule applies to all PWS classified as community or nontransient, noncommunity water systems (NTNCWS) that treat their water with a chemical disinfectant for either primary or residual treatment.

c. COMPLIANCE TIMELINES. Large surface water systems (≥ 10,000) are required to comply with the Stage 1 D/DBP 3 years after rule promulgation, i.e., by December 2001. These systems are also known as large Subpart H systems meaning they have been required in the past to meet SWTR requirements. Ground water systems and small surface water systems must comply with the Stage 1 D/DBP Rule by December 2003.

d. MAXIMUM D/DBP LEVELS. The "maximum" goals and levels are summarized in Table 1 below.

- MRDLGs are set for chlorine, chloramines and chlorine dioxide.
- MRDLs are set for the same disinfectants. Together, establishing MRDLGs and MRDLs should protect consumers from potentially harmful concentrations of disinfectants.
- MCLGs are set for the four compounds comprising the TTHMs, two of the HAA5s and the by-products bromate and chlorite.
- The MCL for TTHM has been reduced from 0.100 mg/L to 0.080 mg/L. An MCL is established for the HAA5 at 0.060 mg/L.

TABLE 1. MRDLGs, MRDLs, MCLGs and MCLs for Stage 1 D/DBPs

DISINFECTANT RESIDUAL	MRDLG (mg/L)	MRDL (mg/L)	COMPLIANCE BASED ON
Chlorine	4 (as free Cl_2)	4.0 (as free Cl_2)	Annual Average
Chloramine	4 (as Cl_2)	4.0 (as Cl_2)	Annual Average
Chlorine Dioxide	0.8 (as ClO_2)	0.8 (as ClO_2)	Daily Samples
DISINFECTION BYPRODUCTS	MCLG (mg/L)	MCL (mg/L)	COMPLIANCE BASED ON
Total trihalomethanes (TTHM)[1] - Chloroform - Bromodichloromethane - Dibromochloromethane - Bromoform	N/A 0 0 0.06 0	0.080	Annual Average
Haloacetic acids (five) (HAA5)[2] - Dichloroacetic acid - Trichloroacetic acid	N/A 0 0.3	0.060	Annual Average
Chlorite	0.8	1.0	Monthly Average
Bromate	0	0.010	Annual Average

N/A - Not applicable because there are individual MCLGs for TTHMs or HAAs

1-TTHMs are the sum of the concentrations of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

2-HAA5s are the sum of the concentrations of mono-, di-, and trichloroacetic acids and mono- and dibromoacetic acids.

Water systems that use surface water or ground water under the direct influence of surface water and use conventional filtration treatment are required to remove specified percentages of organic materials, measured as total organic carbon (TOC), that may react with disinfectants to form DBPs (See Table 2). Removal will be achieved through a treatment technique (enhanced coagulation or enhanced softening) unless a system meets alternative criteria.

e. MONITORING FOR DISINFECTANTS. Water systems will be required to routinely monitor for the disinfectants used in their system.

(1) Monitoring for Free Chlorine and Chloramine Residual.

(a) All PWS using either free chlorine or chloramines must monitor the disinfectant levels in the distribution system at sample points used for total coliform monitoring at the time total coliform samples are collected.

(b) To determine compliance, average all monthly samples. Monthly samples are then arithmetically averaged to determine the quarterly average. For compliance the most recent four-quarter average cannot exceed the MRDL.

(c) The water systems must maintain records and report to their state the following: number of monthly residual test samples during a quarter; monthly arithmetic average of all residual samples tested each month for a 12-month period; the average of the previous 12 monthly averages; whether the MRDL has been exceeded.

(2) Monitoring for Chlorine Dioxide Residual.

(a) If a water system uses chlorine dioxode rather than free chlorine or chloramine, other monitoring requirements apply. A significant difference is that monitoring for chlorine dioxide applies to transient non-community water systems (TNCWS) as well as community and the NTNC systems. The disinfectant residual must be measured daily at the entrance to the distribution system. If the MRDL of 0.8 mg/L is exceeded, three follow-up samples must be collected from the distribution system (reference 20).

(b) Nonacute and acute violations of this monitoring requirement have been identified. An example of a nonacute violation is the failure to monitor at the distribution system entrance following a MRDL exceedance. Another nonacute violation is two consecutive daily entry point samples exceed 0.8 mg/L but all follow-up distribution system samples remain below 0.8 mg/L. An acute violation occurs when an entry point sample exceeds 0.8 mg/L and one or more of the follow-up distribution system samples also exceeds 0.8 mg/L.

(c) Water systems using chlorine dioxide must report the following to their primacy state: locations and results of residual samples during the past quarter; whether the MRDL was exceeded and if so, was it exceeded during two consecutive samples; was the violation acute or nonacute.

f. MONITORING FOR DBP. Another requirement of the Stage 1 D/DBP is that monitoring must be performed for the DBP. Monitoring schedules are implemented according to the size of the water system and the type of disinfectant.

(1) General. Under the Stage 1 D/DBP the current MCL of 0.10 mg/L for TTHM will be replaced with a new MCL of 0.080 mg/L with effective dates of December 2001 effective date

(large systems) and December 2003 (small systems and ground water). The system must submit a DBP monitoring plan to their primacy state with 30 days of the effective compliance dates. The monitoring plan must reflect the complete distribution system and include sample collection points and information regarding calculating MCL, MRDL and treatment technique compliance.

(2) The TTHM and HAA5 – Large Subpart H Systems (≥ 10,000).

(a) Routine Monitoring. Compliance monitoring samples shall be taken under normal operating conditions. Samples for TTHM and HAA5 are collected at the same time. Similar to current TTHM requirements, systems must collect compliance samples from four locations within the distribution system on a quarterly basis. Three locations should represent average water residence time. The fourth sample should be from a location representing maximum residence time. The arithmetic average for the TTHMs and HAA5 is calculated for the quarter. Compliance is based on a running annual average for the most recent 4 quarters.

(b) Reduced Monitoring. The system can qualify for reduced monitoring if certain criteria are met. The TTHM annual average must be ≤ 0.040 mg/l and the HAA5 average must be ≤ 0.030 mg/L. Additionally, the source water total organic carbon (TOC) level may not exceed 4.0 mg/L for the previous year of monthly averages. Under these conditions the TTHM and HAA5 monitoring may be reduced to one quarterly sample collected from a maximum residence point.

(3) The TTHM/HAA5 – Small Subpart H Systems (500-9,999).

(a) Routine Monitoring. Compliance monitoring samples shall be taken under normal operating conditions. Samples for TTHM and HAA5 are collected at the same time. Typically one sample will be collected each quarter from a location representing maximum residence time. If more than one sample is collected in a quarter, at least 25 percent must be from the maximum point.

(b) Reduced Monitoring. The small system can qualify for reduced monitoring if the same criteria described above for large system reduced monitoring are met. In that case the small system may, with state approval collect one sample per year from the maximum residence point during the month of warmest water temperature. Compliance would be based on the average for samples collected during the year.

(4) The TTHM/HAA5 – Large Ground Water Systems (≥ 10,000). Both routine and reduced monitoring requirements for these systems are the same as those described for Small Subpart H Systems. If the system monitors on a less than quarterly basis, compliance is based on the DBP average for the year.

(5) TTHM/HAA5 – Small Ground Water Systems (< 10,000). With state approval systems in this category will routinely collect one sample per year from the maximum residence point during the month of warmest water temperature.

(6) Monitoring for Chlorite. Community water systems and NTNCWS that disinfect with chlorine dioxide must perform monitoring for chlorite. A daily sample at the entrance to the distribution system must be tested with no allowance for reduced monitoring. In addition, monthly monitoring consists of three samples – from the entrance, a point of average residence time and a point of maximum residence time. Compliance is based on the 3-sample set average < 1.0 mg/L. If a system exceeds the MCL, the state and the public must be notified.

(7) Monitoring for Bromate. Community water systems and NTNCWS that use ozone as a disinfectant must monitor for the presence of the DBP bromate. A system tests monthly samples from the entrance to the distribution system. Compliance with the MCL is based on an annual arithmetic average that is calculated quarterly. An allowance for reduced monitoring, to one sample per quarter, is possible as long as the annual average source water bromide concentration remains < 0.05 mg/L.

g. BEST AVAILABLE TECHNOLOGIES (BAT). The EPA has designated a number of treatment techniques, known as best available technologies (BAT), that are recommended to reduce and control the presence of disinfectants and resulting DBPs. The BATs that have been identified for chlorine, chloramine, and chlorine dioxide residuals and TTHM, HAA5, chlorite and bromate are described at Appendix C.

h. TREATMENT TECHNIQUE - REMOVAL OF DBP PRECURSORS.

(1) Subpart H systems using conventional filtration may be required to apply treatment to further reduce the development of DBPs through total organic carbon (TOC) removal. The additional treatment is by either enhanced coagulation or enhanced softening. To avoid this requirement one the following "alternative compliance" criteria must be met.

(a) The source water annual TOC average must be < 2.0 mg/L.

(b) The treated water annual average TOC must be < 2.0 mg/L.

(c) The source water TOC < 4.0 mg/L, annual average alkalinity > 60 mg/L, annual average TTHM ≤ 0.040, and annual average HAA5 ≤ 0.030.

(d) The PWS makes a irrevocable financial commitment to implement technologies to limit the TTHM and HAA5 levels to 0.040 and 0.030, respectively.

(e) The PWS uses only chlorine for primary/residual disinfection and annual averages for TTHM ≤ 0.040 mg/L and for HAA5 ≤ 0.030 mg/L.

(f) specific ultraviolet absorbance (SUVA) ≤ 2.0 L/mg-m (annual average) for the source water or the treated water.

(2) Treatment using either enhanced coagulation or enhanced softening will be implemented according to a step-wise approach with allowances for system specific conditions. Step 1 is to achieve TOC removals as listed in Table 2 below. At state discretion, the following

criteria may be applied to water systems that cannot achieve the TOC removal: softening that reduces treated water alkalinity to < 60 mg/L or softening that removes at least 10 mg/L of magnesium hardness (annual average).

Table 2. Required Removal of Total Organic Carbon by Enhanced Coagulation and Enhanced Softening for Subpart H Systems Using Conventional Treatment[1]

Source Water TOC (mg/L)	Source Water Alkalinity (mg/L as $CaCO_3$)		
	0-60	>60-120	>120[2]
>2.0-4.0	35%	25%	15%
>4.0-8.0	45%	35%	25%
>8.0	50%	40%	30%

[1]Systems meeting at least one of the alternative compliance criteria in the rule are not required to meet the removals in this table.
[2]Systems practicing softening must meet the TOC removal requirements in the last column to the right.

(3) Under Step 2, a system may apply for alternative minimum TOC removal by softening or coagulation. Systems using enhanced softening must achieve removals listed in the right column, Table 2. Systems using enhanced coagulation must determine a minimum TOC removal performance level. This is accomplished by setting coagulant dosage and pH so that 10 mg/L increments of alum result in TOC removal of 0.3 mg/L. This approach is applied until the state approves a new value based on bench scale testing.

(4) The actual and "required" percent of TOC removal are compared to determine compliance with the treatment technique requirements. If the actual TOC removal divided by the required TOC removal is < 1.00, the system does not comply with percent removal requirements.

7. EPA TECHNICAL MANUALS.

a. The EPA will publish a number of guidance manuals to support the IESWTR and the Stage 1 D/DBP Rule. The manuals will aid EPA, state agencies, and affected public water systems in implementing the two interrelated rules, and will help to ensure consistency of rule implementation. The EPA anticipates that the manuals will be available for review by mid-1999. The guidance manuals will be finalized throughout 1999. The EPA intends to post the completed guidance manuals at the Office of Ground Water and Drinking Water website www.epa.gov/OGWDW and link www.epa.gov/safewater. Another source to obtain information about the status of the guidance manuals is the EPA Safe Drinking Water Hotline at 1-800-426-4791. The manuals are briefly described below. More detailed explanation of each guidance manual is provided at Appendix D.

b. Disinfection Benchmarking Guidance Manual. This manual will help determine whether a disinfection profile (an evaluation of current disinfection practice) is required with instructions on how to do one. It also determines when a disinfection benchmark must be determined, how to extract it from the profile, and how a public water system must use the benchmark, in consultation with the state, to assure protection from microbial risk is maintained when the system changes disinfection practice.

c. Turbidity Guidance Manual. The first section of this manual provides technical information regarding specific requirements of the IESWTR relating to turbidity and is intended for experienced operators and others in the regulated community. The second section of the document provides background on concepts surrounding turbidity and serves as a primer for less experienced operators and individuals.

d. The M/DBP Simultaneous Compliance Manual. In this manual information will be provided to assist public water systems on complying simultaneously with various drinking water regulations (e.g., Stage 1 D/DBP Rule, IESWTR, Lead and Copper Rule, and the Total Coliform Rule). The manual will include operational problems systems may encounter when implementing these rules.

e. Guidance Manual for Conducting Sanitary Surveys of Public Water Systems. This guidance manual will provide an overview of how to conduct a sanitary survey of all water systems using surface water and ground water under the direct influence of surface water. It is intended to help state agencies improve their sanitary survey programs where needed.

f. Unfiltered Water Supply Guidance Manual. This manual will supplement the existing Interim Surface Water Treatment Rule guidance for unfiltered surface water supplies and to identify the issues and requirements associated with the new regulations.

g. Uncovered Finished Water Reservoirs. This manual will provide detailed information on the following subjects: developing and implementing comprehensive open finished water reservoir management plans based on site-specific conditions; identifying potential sources of contamination in open finished water reservoirs and potential mitigation measures; employing different methods to control the degradation of water quality while it resides in the reservoir; monitoring schemes that can be used to characterize water quality and identify water quality degradation before it becomes severe and is difficult to correct.

h. Guidance Manual for Enhanced Coagulation and Enhanced Precipitative Softening. Information in this manual will assist utilities in implementing, monitoring, and complying with the treatment technique requirements in the final Stage 1 D/DBP Rule and guidance to state staff responsible for implementing the treatment requirements.

i. Alternative Disinfectants and Oxidants Guidance Manual. This manual will include technical data and engineering information on disinfectants and oxidants that are not as commonly used as chlorine. Systems can evaluate their options for developing disinfection schemes to control water quality problems such as zebra mussels and Asiatic clams, and oxidation to control water quality problems associated with iron and manganese.

8. FUTURE MICROBIAL/DBP REGULATIONS. The EPA must finalize and promulgate additional rules to meet requirements of the 1996 SDWA Amendments as discussed below.

a. LONG TERM 1 ESWTR. This rule will strengthen the treatment for microbes that small water systems, serving less than 10,000 persons, must provide. It is anticipated that there will be

elements similar to the IESWTR to include tighter turbidity control and individual filter monitoring that will apply to small water systems.

b. LONG TERM 2 ESWTR AND STAGE 2 DBP. Currently, the EPA plans to finalize the rules simultaneously because the requirements are so closely linked. The EPA will use monitoring data and lessons learned from implementation of the IESWTR and the Stage 1 D/DBP rule to provide additional public health protection, if required, from microbial pathogens and DBPs. An important note is that under Stage 2 DBP the MCLs for TTHMs and HAA5 are expected to be reduced even further. Levels as low as 40 and 30 mg/L respectively may be set. Water treatment processes may have to be significantly improved.

c. GROUND WATER RULE. This rule will be implemented to protect those consumers who rely on ground water as their drinking water source. Over 109 million people in the U.S. are served by about 158,000 ground water systems. Generally, ground water is less subject to microbial contamination than surface water supplies. However, the EPA has accumulated ample evidence of contaminated ground water systems and resulting illnesses to warrant such a regulation. The ground water rule is expected to specify minimum levels of disinfection and other health protective measures.

Table 3. Schedule of M-DBP Rules

December 1998 -- Final Rule	Interim Enhanced Surface Water Treatment Rule & Stage 1 Disinfection Byproduct Rule
August 2000 -- Final Rule	Filter Backwash Recycling Rule
November 2000 -- Final Rule	Long Term 1 Enhanced Surface Water Treatment Rule & Ground Water Rule
May 2002 -- Final Rule	Stage 2 Disinfection Byproduct Rule & Long Term 2 Enhanced Surface Water Treatment Rule

9. CONCLUSIONS.

a. The IESWTR and the Stage 1 D/DBP Rule have been promulgated by the EPA in an effort to reduce health threats from both microbial pathogens and disinfectants and by-products formed during the disinfection process.

b. The rules are very complex. Implementing the monitoring requirements and treatment changes required will impact numerous Army water treatment facilities.

c. Army personnel responsible for managing/operating Army water systems should work closely with the primacy State authority to seek guidance and ensure compliance.

d. Additionally, it is important to seek any necessary assistance from other sources such as the USACHPPM or the USAEC.

e. Future rules will be more restrictive, e.g., DBP criteria will be more stringent as MCLs may be reduced by half.

10. ACTIONS FOR ARMY WATER SUPPLIERS TO TAKE.

a. CONUS/OCONUS. This information paper describes numerous requirements that will be imposed on PWS throughout the United States. Army water suppliers in CONUS that operate a PWS will be subject to appropriate D/DBP Rule requirements based on system size. A number of Army PWS using surface water sources must meet the IESWTR requirements. The IESWTR and D/DBP Rule requirements would affect OCONUS Army water systems upon appropriate incorporation into the local FGS, based on future revisions to the 1999 OEBGD.

b. RESOURCE PLANNING. Some steps for compliance, such as simultaneous monitoring for TTHM and HAA5 under the IESWTR should be currently underway. Planning in order to meet future requirements is advised. Army water suppliers should include the programming of resources to meet compliance requirements as part of the planning process. Two example Environmental Program Requirement (EPR) reports are presented in Appendix E. These examples indicate the types of water system evaluations and improvements that may be required for compliance. The following section summarizes steps that Army water systems should be considering or implementing, according to each rule.

c. PREPARING FOR THE IESWTR.

(1) Simultaneous Monitoring for TTHMs and HAA5. Army water systems using surface water sources and serving ≥ 10,000 people which must perform the monitoring to determine whether a disinfection profile is required should have received notification from their primacy State. This requirement is expected to apply to Army systems that have previously performed TTHM monitoring.

(a) Systems should collect the required DBP samples at the typical locations within the distribution system used for TTHM monitoring, i.e., a minimum of four samples from the system and one of the locations representing maximum residence time.

(b) Coordinate with your state-certified drinking water laboratory to analyze for HAA5 in addition to TTHMs.

(c) The monitoring and reporting of TTHM and HAA5 results must begin by the end of June 1999. Continue monitoring/reporting of quarterly samples at approximately equal intervals of 90 days, until four quarters of analyses are completed prior to the end of March 2000. This guidance was issued previously by the USAEC (reference 10).

(d) After 1 year of DBP monitoring has been completed, determine whether the annual average for either the TTHM or HAA5 has exceeded the 80 percent MCL mark, 0.064 mg/L and 0.048 mg/L respectively. A disinfection profile will be required for systems meeting/exceeding those levels. Contact your primacy State to assist in this process.

(e) Pursue disinfection profiling before starting TTHM/HAA5 quarterly monitoring if desired. Notify the state authority by 16 December 1999 if choosing that course.

(2) Filtered Water Turbidity Monitoring.

(a) Ensure the ability to monitor water turbidity from each filter on a continuous basis.

(b) Examine current combined filtered water turbidity data to determine the ability to comply with the more stringent turbidity requirement (0.3 NTU 95 percent of the time, with a maximum of 1.0 NTU). Pursue corrective measures if necessary.

d. PREPARING FOR THE D/DBP RULE.

(1) Small Army water systems (serving < 10,000 people) should begin to develop TTHM/HAA5 data in accordance with the approach for the IESWTR as described above, for larger systems.

(2) All systems should evaluate routine residual monitoring to determine the ability to comply with the disinfectant residual requirements. Pursue corrective measures if necessary.

e. COORDINATION WITH PRIMACY STATE AUTHORITY. Contact the state regulatory authority for any questions concerning the applicability of the IESWTR or the Stage 1 D/DBP Rule.

f. THE EPA GUIDANCE MANUALS. To assist in pursuing compliance, obtain relevant EPA guidance manuals, described in paragraph 7 and Appendix D.

g. TECHNICAL ASSISTANCE. Pursue assistance, if necessary, from sources such as the USACHPPM, Water Supply Management Program at DSN 584-3919/commercial 410-436-3919 or from the USAEC, Environmental Compliance Division at DSN 584-7068/commercial 410-436-7068.

John K. Brokaw

JOHN K. BROKAW
Supervisory Microbiologist
Water Supply Management Program

APPROVED:

JERRY A. VALCIK, P.E., DEE
Program Manager
Water Supply Management

APPENDIX A
REFERENCES

1. Title 40, Code of Federal Regulations, 1998 rev., Part 141, National Primary Drinking Water Regulations (NPDWR),

3. USACHPPM Technical Guide 179, Guidance for Providing Safe Drinking Water at Army Installations, November 1995.

2. Public Law 104-182, 6 August 1996, The Safe Drinking Water Act Amendments of 1996.

4. Final Rule, National Primary Drinking Water Regulations (NPDWR): Interim Enhanced Surface Water Treatment, 63 Federal Register 69478, 16 December 1998.

5. Final Rule, NPDWR: Disinfectants and Disinfection By-Products, 63 Federal Register 69390, 16 December 1998.

6. U.S. Environmental Protection Agency (EPA), EPA No. 815-F-98-0014, Drinking Water Priority Rulemaking: Microbial and Disinfection Byproducts Rules, Office of Ground Water and Drinking Water (OGWDW), December 1998.

7. LeChevalier, M.W., et.al., Occurrence of Giardia and Cryptosporidium spp. in Surface Water Supplies, Applied and Environmental Microbiology, Vol 57, 9:2610, 1991.

8. Final Rule, NPDWR: Surface Water Treatment Rule, 54 Federal Register 27486, 29 June 1989.

9. Final Rule, NPDWR: Total Coliform Rule, 54 Federal Register 27544, 29 June 1989.

10. Interim Rule, National Interim Primary Drinking Water Regulations, 44 Federal Register 68624, November 1979.

11. Final Rule, NPDWR: Information Collection Rule, 61 Federal Register 24354, 14 May 1996.

12. Department of Defense (DOD) Overseas Environmental Baseline Guidance Document (OEBGD) prepared by the DOD Overseas Environmental Task Force, October 1992.

13. Draft, DOD OEBGD, prepared by the DOD Overseas Environmental Task Force, 15 March 1998.

14. U.S. EPA, EPA No. 815-F-98-009, Interim Enhanced Surface Water Treatment Rule, OGWDW, December 1998.

15. U.S. EPA, EPA No. 625/6-89-020, Technology Transfer Handbook: Retrofitting POTWs, Center for Environmental Research Information, July 1989.

16. U.S. EPA, EPA No. 625/6-91/027, Technology Transfer Handbook: Optimizing Water Treatment Plant Performance Using the Composite Correction Program, Office of Research and Development, February 1991.

17. Pontius, Frederick W., Complying With the Interim Enhanced Surface Water Treatment Rule, Journal AWWA, Vol. 91, April 1999.

18. Memorandum, USAEC, SFIM-AEC-EQC, subject: 1999 Drinking Water Monitoring Requirements – Interim Enhanced Surface Water Treatment Rule, 26 April 1999

19. U.S. EPA, EPA No. 815-F-98-010, Stage 1 Disinfectants and Disinfection By-Products Rule, OGWDW, December 1998.

20. Pontius, Frederick W., Complying With the Stage 1 D/DBP Rule, Journal AWWA, Vol. 91, March 1999.

APPENDIX B
DEFINITIONS

Best available technology (BAT) – the best technology, treatment techniques, or other means available, as identified by EPA, after examination under field conditions and not solely under laboratory conditions. Refer to Appendix C.

Community water system – a public water system providing water to at least 15 service connections used by year-round residents or regularly serving at least 25 year-round residents.

Enhanced coagulation – the addition of enough coagulant to improve removal of disinfection by-product precursors by conventional filtration.

Enhanced softening – the improved removal of DBP precursors by precipatative softening.

Granular Activated Carbon 10 (GAC10) – granular activated carbon filter beds with an empty bed contact time of 10 minutes based on average daily flow and a carbon reactivation frequency of every 180 days.

Gound water under direct influence (GWUDI) – any water beneath the surface of the ground with either 1) significant occurrence of insects, other macroorganisms, or large diameter pathogens; or 2) significant and relatively rapid shifts in water characteristics such as turbidity or temperature which closely correlate to climatological or surface water conditions.

Haloacetic acids – sum of the concentration in mg/L of the five haloacetic acid compounds (monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid).

Maximum contaminant level – the maximum permissable level of a contaminant in water which is delivered to any user of a public water system.

Maximum contaminant level goal – MCLGs are non-enforceable health goals for public water systems. MCLGs are set at levels that, in the EPA Administrator's judgment, allow no known or anticipated adverse effect on the health of persons to occur and that allow an adequate margin of safety.

Maximum residual disinfectant level – the concentration of disinfectant added for water treatment that may not be exceeded at the consumer's tap, without an unacceptable possibility of adverse health effects.

Maximum residual disinfectant level goal – the maximum concentration of a disinfectant added for water treatment at which no known or anticipated adverse effect on human health would occur, with an adequate margin of safety. The MRDLGs are non-enforceable health goals and do not reflect the benefit of the addition of a chemical disinfectant for control of waterborne microbial contaminants.

Nephelometric turbidity unit – measurement of turbidity, or the scattering of light, due to materials suspended in water.

Nontransient, noncommunity water system (NTNCWS) – a water system that is not a community water system and that regularly serves at least 25 of the same persons over 6 months per year. Common types of NTNCWS are those serving schools, day care centers, factories, and hospitals.

Public water system – a system for provision to the public of water for human consumption through pipes or other conveyance, if such system has at least 15 service connections or regularly serves an average of minimum of 25 persons at least 60 days per year.

Subpart H systems – public water systems that use surface water or ground water under the direct influence of surface water as a source and that are subject to the requirements of 40 CFR 141, Subpart H (Surface Water Treatment Rule).

Specific ultraviolet absorbance (SUVA) – specific ultraviolet light absorbance at 254 nm, an indicator of the humic content of the water.

Total organic carbon – measured using heat, oxygen, ultraviolet radiation chemical oxidants, or combinations of these oxidants that convert organic carbon to carbon dioxide.

Total trihalomethanes (TTHM) – the sum of the concentration in milligrams per liter of the trihalomethane compounds chloroform, bromodichloromethane, dibromochloromethane, and bromoform, rounded to two significant figures.

APPENDIX C
BEST AVAILABLE TECHNOLOGIES

The following methods have been identified by the EPA as the best options to reduce health effects that may be caused by exposure to disinfectant or disinfection by-products.

DISINFECTANTS

Chlorine residual – control of treatment processes to reduce disinfectant demand and control of disinfection processes to reduce disinfectant concentrations.

Chloramine residual – control of treatment processes to reduce disinfectant demand and control of disinfection processes to reduce disinfectant concentrations.

Chlorine dioxide residual – control of treatment processes to reduce disinfectant demand and control of disinfection processes to reduce disinfectant concentrations.

DISINFECTION BY-PRODUCTS

Total trihalomethanes – enhanced coagulation or enhanced softening or GAC10 with chlorine as the primary and residual disinfectant.

Total Haloacetic acids – enhanced coagulation or enhanced softening or GAC10 with chlorine as the primary and residual disinfectant.

Chlorite – control of treatment processes to reduce disinfectant demand and control of disinfection processes to reduce disinfectant concentrations.

Bromate – control of the ozone treatment process to reduce the production of bromate.

APPENDIX D
EPA GUIDANCE MANUAL SUMMARIES

Most of the EPA Guidance Manuals have been published during the summer 1999. EPA document numbers are identified for each manual. For more information, contact EPA's Safe Drinking Water Hotline, 1-800-426-4791, or see the Office of Ground Water and Drinking Water web page at http://www.epa.gov/safewater/ standards.html.

Disinfection Profiling and Benchmarking Guidance Manual EPA 815-R-99-013 August 1999

SUMMARY

The manual provides detailed information on the following subjects: applicability of the profiling and benchmarking requirements to public water systems; procedures for generating a disinfection profile, including example profiles; methods for calculating the disinfection benchmark, including example calculations; the use of the benchmark in modifying disinfection practices, communicating with the state, and assessing significant changes to disinfection practices; te development of the profiling and benchmarking regulations; the significance of the log inactivation concept and CT values for inactivations achieved by various disinfectants; and the determination of contact time.

The objective of this guidance manual is to help Public Water Systems (PWSs) in implementing the practice of disinfection profiling and benchmarking as required under the Interim Enhanced Surface Water Treatment Rule (IESWTR) promulgated December 16, 1998. The IESWTR applies to surface water or Ground Water Under Direct Influence (GWUDI) of surface water systems serving 10,000 people or more. This guidance manual describes the applicability of the profiling and benchmarking provisions to PWSs and details the procedures for generating a disinfection profile and calculating the disinfection benchmark. Finally, this guidance manual provides guidance to PWSs on determining "significant changes" to disinfection practices, communicating with the State, and the use of the disinfection benchmark in modifying disinfection practices. The IESWTR defines a disinfection profile as a compilation of daily *Giardia* and/or virus log inactivation over a period of a year or more. Disinfection benchmarking is a baseline or benchmark of historical microbial inactivation practices developed from disinfection profiling data.

APPLICABILITY

Systems are required to develop a disinfection profile for *Giardia* if their distribution system DBP running annual average for either TTHM or HAA5 concentrations in the distribution system is greater than or equal to 0.064 mg/L or 0.048 mg/L, respectively. Systems need one year of TTHM and HAA5 same time period data for disinfection profile determination.

Systems that are required to profile and intend to "significantly" modify their disinfection practice are required under the IESWTR to develop disinfection benchmarking for *Giardia*. Significant changes to disinfection practices are defined under IESWTR as:

- Moving the point of disinfection
- Changing the type of disinfectant
- Changing the disinfection process
- Making any other change designated as significant by the State.

Systems planing to modify their disinfection practices by adding or switching disinfectants to ozone or chloramines are required to develop a disinfection profile and benchmark for viruses. Moreover, EPA strongly recommends that systems switching to chlorine dioxide also develop a virus profile.

CREATING A DISINFECTION PROFILE

Systems required to develop a disinfection profile must:

- Conduct daily monitoring for a minimum period of one year by no later than March 2001.
- And may also use 1 or 2 years of acceptable grandfathered data, in addition to the 1-year of new operational data.
- Or may use grandfathered data to develop a 3-year disinfection profile.

Systems must coordinate with the State to confirm acceptability of grandfathered data no later than March 2001, but must conduct the required monitoring until the State approves the system's request to use grandfathered data.

USE OF CT VALUES FOR DISINFECTION PROFILING

The Surface Water Treatment Rule (SWTR) requires physical removal and/or inactivation of 3-logs (99.9 percent) of *Giardia* and 4-logs (99.99 percent) of viruses. For disinfection profiling and benchmarking, the CT (see p. v for definition) approach will be used to compute the log inactivation of *Giardia* or viruses achieved during water treatment.

To use the SWTR CT tables, disinfectant type, temperature, and pH (for chlorine only) data are needed. Using this operating information, the CT value corresponding to inactivation of 3-logs of *Giardia* ($C_{T3\text{-}log,\ Giardia}$) and/or 4-logs of viruses ($C_{T4\text{-}log,\ virus}$) can be read from the SWTR CT tables. Once the CT required to achieve 3-log inactivation of *Giardia* and/or 4-log inactivation of viruses is determined, the actual plant CT needs to be calculated. By determining contact time (T_{10}) for each treatment unit within a disinfection segment (based on baffling factors or tracer studies) T_{10} is multiplied by residual disinfectant concentration for the disinfection segment.

The plant log inactivation for *Giardia* and/or viruses is the sum of log inactivation for each segment. From the daily estimated plant log inactivation data, a disinfection profile can be created.

DETERMINING THE BENCHMARK

From the daily plant log inactivation records, systems need to compute the average log inactivation for each calendar month. The lowest monthly average log inactivation values for each 12-month period are then averaged to determine the benchmark. If one year of data is available, the lowest monthly average log inactivation is the disinfection benchmark.

Systems considering modifications to the disinfection practices can use the benchmark to assess modification impacts. This assessment is done by calculating the "modification benchmark" and comparing it to the current benchmark. If the modification to disinfection practice results in a lower inactivation, an alternative disinfection benchmark may improve a system's ability to meet the DBPR MCLs without significantly compromising existing microbial protection.

Systems, under State guidance, may choose to develop an alternative benchmark that is lower than the existing benchmark. For example, a system may choose to develop an alternative benchmark when the system cannot simultaneously meet the disinfection benchmark and the Stage 1 DBPR MCLs. The system may also choose this course of action because of very high levels of microbial inactivation and/or high quality source water that has low pathogen occurrence levels.

Turbidity Guidance Manual EPA 815-R-99-010 April 1999

SUMMARY

The Interim Enhanced Surface Water Treatment Rule (IESWTR) establishes a number of provisions related to the performance of filters in drinking water treatment. These provisions include treatment technique requirements restricting turbidity levels in the combined filter effluent, as well as monitoring requirements for individual filters at conventional and direct filtration plants. These requirements are designed to decrease the risk from waterborne microbial pathogens by limiting levels of particulate material in finished water.

The objective of the guidance manual is to provide public water systems (PWSs) with guidance for complying with the turbidity provisions found within the IESWTR. The primary audience of the guidance manual is utility personnel at public water systems which utilize filtration and the staff of state drinking water programs that work with PWSs to protect water quality.

The document is divided into two sections. The first section contains technical information regarding specific requirements of the IESWTR relating to turbidity and is intended for experienced operators and others in the regulated community. The second section of the document provides background on concepts surrounding turbidity and serves as a primer for less experienced operators and individuals.

Summary of Chapters

As noted, the document is broken up into two sections. The first section of the manual outlines the specific requirements of the rule and includes detailed information specific to the rule. Section 1 consists of Chapters 2 through 6:

Chapter 2 - Turbidity Requirements: IESWTR

Chapter 2 outlines the regulatory requirements, reporting and recordkeeping requirements, and additional compliance aspects of the IESWTR related to turbidity. Flow charts are provided which graphically demonstrate the requirements.

Chapter 3 - Turbidity Methods & Measurement

Chapter 3 provides information regarding approved turbidity methods, analytical issues associated with turbidimeters and turbidity measurement, quality assurance and quality control issues, and data collection and management issues.

Chapter 4 – Approach for Compliance

Chapter 4 provides information on EPA's suggested approach for compliance with turbidity requirements of the IESWTR. Plant optimization is the focus of this chapter, and areas are highlighted which, in the experience of the Agency and other water professionals, most often can be improved to optimize water treatment at systems. Two programs, the Composite Correction Program and the Partnership for Safe Drinking Water, are briefly discussed as systems are encouraged to utilize these programs to optimize plant performance.

Chapter 5 – Individual Filter Self Assessment

Chapter 5 provides detailed guidance on conducting a filter self assessment. Necessary components are discussed including conducting filter profiles, assessing hydraulic loading conditions, and assessing support media and underdrains. Systems may be required to conduct an individual filter self assessment based on individual filter monitoring results.

Chapter 6 – Comprehensive Performance Evaluation

Chapter 6 provides a general overview of the Composite Correction Program (CCP) and specifically the first component of the CCP, the Comprehensive Performance Evaluation (CPE). Fundamental concepts are discussed including major CPE components, standard CPE activities and CPE quality control measures. Systems may be required to arrange for a CPE based on individual filter monitoring results.

The second section of the manual provides background in order to provide readers with an understanding of basic concepts that underlie turbidity and the provisions found in the IESWTR.

Chapter 7 – Importance of Turbidity

Chapter 7 provides an introduction into the importance of turbidity and includes background on turbidity as a water quality parameter. It discusses the significance of turbidity to human health, provides a brief discussion of waterborne disease outbreaks, and the relationship between turbidity removal and pathogen removal.

Chapter 8 – Particles Contributing to Turbidity

Chapter 8 provides an overview of the characteristics of particles which contribute to turbidity. The section provides brief discussions of organic, inorganic, and biotic particles, particles created during the treatment process, and a brief introduction into the electrokinetic properties of particles.

Chapter 9 – Turbidity in Source Water

Chapter 9 describes the various factors that effect turbidity in rivers, lakes and reservoirs, and groundwater under the direct influence (GWUDI). The chapter also includes information on other watershed considerations that effect turbidity.

Chapter 10 – Turbidity Through the Treatment Process

Chapter 10 provides a general description of the typical treatment processes intended to remove suspended solids and reduce turbidity as well as information on the level of turbidity reduction that is commonly achieved through each.

Chapter 11 – Basic Turbidimeter Design and Concepts

Chapter 11 provides readers with basic information on turbidimeter designs, measuring principals, design configurations, and various types of turbidimeters.

Alternative Disinfectants and Oxidants Guidance Manual EPA 815-R-99-014
April 1999
SUMMARY

The manual discusses six disinfectants and oxidants: ozone, chlorine dioxide, potassium permanganate, chloramines, ozone/hydrogen peroxide combinations, and ultraviolet light. A decision tree is provided to assist in evaluating which disinfectant(s) is most appropriate given certain site-specific conditions (e.g., water quality conditions, existing treatment and operator skill). The manual also contains a summary of existing alternative disinfectants use in the United States and cost estimates for the use of alternative disinfectants.

Chlorine is, by far, the most commonly used disinfectant in the drinking water treatment industry (Sawyer et al., 1994). Today, chlorine is used as a primary disinfectant in the vast majority of all surface water treatment plants, being used as a pre-disinfectant in more than 63 percent and as a post-disinfectant in more than 67 percent of all surface water treatment plants (USEPA, 1997). This manual is organized to provide technical data and engineering information on disinfectants that are not as widely used as chlorine. Also, where applicable, this document describes the use of these disinfectants as oxidants and any associated implications.
The U.S. Environmental Protection Agency (EPA) encourages utilities to examine all aspects of their current disinfection practices to identify opportunities to improve the quality of the finished water without reducing microbial protection. The objective of this guidance manual is to describe alternative disinfectants and disinfection techniques that may be used to comply with both the Stage 1 Disinfectants and Disinfection Byproducts Rule (DBPR) and Interim Enhanced

Surface Water Treatment Rule (IESWTR) and highlight advantages and disadvantages of their use.

EPA is not recommending that utilities employ the disinfectants and oxidants discussed in this manual, nor is it advocating that utilities switch from one disinfectant or oxidant to another. EPA acknowledges that selection of the most appropriate disinfection technique is a site-specific decision best left to utility personnel and state agencies. Utilities should use this guidance as an information resource to assist in the selection of appropriate disinfectants and disinfectant schemes to meet their specific goals. Extensive bench and/or pilot scale testing and a thorough review of regulatory requirements should precede changes to disinfection practice. Systems should refer to the Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Works Systems Using Surface Water Sources (AWWA, 1991) to ensure disinfectant schemes meet regulatory log inactivation requirements. Utilities should also refer to EPA's *Disinfection Profiling and Benchmarking Guidance Manual* (currently in production) to ensure compliance with the new regulatory requirements of the IESWTR.

Chapter 1 contains a brief discussion of the background and regulatory context of alternative disinfectants, including an overview of the disinfection profiling and benchmarking approach to evaluate disinfection efficiency. In addition, a decision-making framework is provided that utilities can employ to assess the applicability of various disinfectants and disinfection strategies for individual systems. Chapter 2 presents an overview of disinfection, including the use of chlorine, with the next six chapters of this manual devoted to each of the following alternative disinfectants and oxidants:

- *Chapter 3* - Ozone (O_3);
- *Chapter 4* - Chlorine dioxide (ClO_2);
- *Chapter 5* - Potassium permanganate ($KMnO_4$);
- *Chapter 6* - Chloramine (NH_2Cl);
- *Chapter 7* - Ozone/hydrogen peroxide combinations (O_3/H_2O_2); and
- *Chapter 8* - Ultraviolet radiation (UV).

For each disinfectant, this guidance manual describes the chemistry specific to the disinfection or oxidation process, generation, primary uses and points of application, disinfection byproduct (DBP) formation, pathogen inactivation and disinfection efficacy, the status of analytical methods for residual monitoring, and operational considerations. Chapter 9 provides similar information regarding the use of combined disinfectants. A summary of existing disinfectant usage in the United States is provided in Appendix A. Cost estimates for the use of alternative disinfectants are provided in Appendix B.

Background

The most important use of disinfectants in water treatment is to limit waterborne disease and inactivate pathogenic organisms in water supplies. The first use of chlorine as a continuous process in water treatment was in a small town in Belgium in the early 1900s (White, 1992). Since introduction of filtration and disinfection at water treatment plants in the United States, waterborne diseases such as typhoid and cholera have been virtually eliminated. For example, in Niagara Falls, NY between 1911 and 1915, the number of typhoid cases dropped from 185 deaths per 100,000 population to nearly zero following introduction of filtration and chlorination (White, 1986).

In 1974, researchers in the Netherlands and the United States demonstrated that trihalomethanes (THMs) are formed as a result of drinking water chlorination (Rook, 1974; Bellar et al., 1974). THMs are formed when chlorine or bromide reacts with organic compounds in the water. EPA subsequently conducted surveys confirming widespread occurrence of THMs in chlorinated water supplies in the United States (Symons et al., 1975; USEPA, 1978). THMs and other DBPs have been shown to be carcinogenic, mutagenic, etc. These health risks may be small, but with the large population exposed, need to be taken seriously.

As a result of DBP concerns from chlorine, EPA, as well as the water treatment industry, placed more emphasis on the use of disinfectants other than chlorine. Some of these alternative disinfectants, however, have also been found to produce DBPs as a result of either reactions between disinfectants and compounds in the water or as a natural decay product of the disinfectant itself (McGuire et al., 1990; Legube et al; 1989). These DBPs include:

- Halogenated organics, such as THMs, haloacetic acids, haloketones, and others, that are produced primarily as a result of chlorination.
- Organic oxidation byproducts such as aldehydes, ketones, assimilable organic carbon (AOC), and biodegradable organic carbon (BDOC), that are associated primarily with strong oxidants such as ozone, chlorine, and advanced oxidation; and
- Inorganics such as chlorate and chlorite, associated with chlorine dioxide, and bromate, that is associated with ozone, and has also has been found when chlorine dioxide is exposed to sunlight.

As documented in this manual, the type and amount of DBPs produced during treatment depends largely on disinfectant type, water quality, treatment sequences, contact time, and environmental factors such as temperature and pH.

When considering the use of alternative disinfectants, systems should ensure that the inactivation of pathogenic organisms is not compromised. Pathogens pose an immediate critical public health threat due to the risk of an acute disease outbreak. Although most identified public health risks associated with DBPs are chronic, long-term risks, many systems will be able to lower DBP levels without compromising microbial protection.

M/DBP Simultaneous Compliance Manual EPA 815-R-99-011 August 1999

Objective: To assist public water systems on complying simultaneously with various drinking water regulations (e.g., Stage 1 Disinfectants and Disinfection Byproducts Rule, Interim Enhanced Surface Water Treatment Rule, Lead and Copper Rule and the Total Coliform Rule). The manual discusses operational problems systems may encounter when implementating these rules.

Contents: The manual provides detailed information on the requirements in the Stage 1 Disinfectants and Disinfection Byproducts Rule and the Interim Enhanced Surface Water Treatment Rule and issues involved with simultaneously complying with other rules.

This manual is organized to provide a tool for PWSs, States, and others to consult when

evaluating simultaneous compliance issues and alternatives. Several case studies are presented throughout this document to better illustrate how the guidance can be put into practice. The remaining chapters of this manual are organized as follows:

- **Chapter 2** provides general background information on pathogen inactivation and the role ofdisinfectants in DBP formation. This chapter also describes the Stage 1 DBPR and the IESWTR and some of the known compliance issues.
- **Chapter 3** describes the difficulties a PWS may have in simultaneously meeting regulatory requirements of the Stage 1 DBPR and IESWTR and addresses specific simultaneous compliance issues.
- **Chapter 4** describes the difficulties a PWS may have in simultaneously meeting regulatory requirements of the M-DBPR and LCR and addresses specific simultaneous compliance issues.
- **Chapter 5** describes the difficulties a PWS may have in simultaneously meeting regulatory requirements of the M-DBPR and TCR and addresses specific simultaneous compliance issues.
- **Chapter 6** identifies operational issues associated with implementation of treatment plant modifications and enhancements to achieve simultaneous compliance.
- **Chapter 7** lists the references used in the development of this report.

As outlined in Chapters 1 and 2, the 1996 Amendments to the SDWA require the EPA to develop regulations for the control and monitoring of microbial pathogens and DBPs in drinking water. Two new rules promulgated in response to the 1996 SDWA Amendments arethe Stage 1 DBPR and the IESWTR. These two rules are part of the Microbial and Disinfection Byproduct (M-DBP) cluster of rules discussed in Chapter 1.

The Stage 1 DBPR focuses on minimizing the formation of DBPs in the distribution system of PWSs to reduce the long-term exposure of customers to these potentially carcinogenic compounds through enhanced coagulation or enhanced softening. In contrast, the IESWTR focuses primarily on achieving adequate disinfection and removal of pathogens to protect PWS customers from acute pathogenic exposure that can cause outbreaks of waterborne disease. Since the Stage 1 DBPR is intended to minimize the formation of DBPs and residual disinfectants, this rule may conflict with the IESWTR which specifies levels of treatment techniques required for *Cryptosporidium*.

As a result of the potential conflict inherent in these two rules, EPA sponsored an extensive negotiation process during the development of these regulations. This regulatory negotiation process included extensive input from a variety of stakeholders and resulted in the specific requirements described in Chapter 2.

Both the Stage 1 DBPR and the IESWTR are based on "best available science." Early in the regulatory negotiation process, the Negotiating Committee agreed that the large amount of information necessary to understand how to optimize the use of disinfectants while concurrently minimizing microbial and DBP risks were unavailable. Some of this information, however, will become available as results from ICR are collected and analyzed. Nevertheless, in the interim, it was agreed that EPA would propose the IESWTR and Stage 1 DBPR to extend coverage to community and nontransient, noncommunity public water systems using disinfectants. The Stage 1 DBPR is applicable to all community and nontransient noncommunity systems, while the IESWTR affects only PWSs serving 10,000 or more people that use surface water or ground water under the direct influence of surface water. EPA will promulgate the Long-Term 1 ESWTR, which will update the IESWTR requirements and extend the regulations to systems

serving less than 10,000 persons. Using ICR data and associated research, EPA expects to propose the Stage 2 DBPR and Long-Term 2 ESWTR in late 2000, with promulgation scheduled for May 2002.

Technical guidance for addressing many of the issues associated with meeting the different objectives of the Stage 1 DBPR and the IESWTR are described. Achieving simultaneous compliance for both rules may have significant impacts on many systems. In a few cases, treatment process changes to achieve compliance with one of the regulations may impair a system's ability to meet the requirements of the other regulation unless other changes are made. Conversely, compliance with one regulation may enhance a system's ability to meet the requirements of the second regulation. Chapter 3 highlights many of these potential conflicts between the Stage 1 DBPR and the IESWTR and discusses how compliance can be achieved concurrently. This chapter focuses on three key regulatory components: profiling and benchmarking, inactivation requirements for non-profiling water systems, and enhanced coagulation considerations relating to turbidity.

Guidance Manual for Conducting Sanitary Surveys of Public Water Systems: Surface Water and Ground Water Under the Direct Influence of Surface Water EPA 815-R-99-016 April 1999

Objective: The guidance manual provides an overview of how to conduct a sanitary survey of all water systems using surface water and ground water under the direct influence of surface water. It is intended to help state agencies improve their sanitary survey programs where needed.

Contents: The manual provides information about the objective and regulatory context of sanitary surveys. It covers four principal stages of a sanitary survey: planning, including preparatory steps to be taken by inspectors before conducting the onsite portion; conducting the onsite survey; compiling a sanitary survey report; and performing follow-up activities.

Uncovered Finished Water Reservoirs EPA 815-R-99-011 April 1999

Contents: The manual provides detailed information on the following subjects: developing and implementing comprehensive open finished water reservoir management plans based on site-specific conditions; identifying potential sources of contamination in open finished water reservoirs and potential mitigation measures; employing different methods to control the degradation of water quality while it resides in the reservoir; monitoring schemes that can be used to characterize water quality and identifying water quality degradation before it becomes severe and is difficult to correct.

Guidance Manual for Enhanced Coagulation and Enhanced Precipitative Softening
Objective: To assist utilities in implementing, monitoring, and complying with the treatment technique requirements in the final Stage 1 Disinfectants and Disinfection Byproducts Rule and to provide guidance to state staff responsible for implementing the treatment requirements.

Contents: The manual provides detailed information on the total organic carbon (TOC) removal requirement; explains how to set an alternative TOC removal percentage under the Step 2 procedure; details monitoring, reporting, and compliance requirements; and discusses strategies that can be employed to mitigate the potential secondary effects on plant performance due to implementation of the treatment technique.

Unfiltered Water Supply Guidance Manual
Objective: To supplement the existing Interim Surface Water Treatment Rule guidance for unfiltered surface water supplies and to identify the issues and requirements associated with the new regulations.

Contents: This manual discusses provisions of the Interim Enhanced Surface Water Treatment Rule that will impact unfiltered surface water and; provides guidance on the development of watershed control programs or enhancements of existing watershed control programs to address *Cryptosporidium.* In addition, it provides information and guidance on monitoring for *Cryptosporidium.*

APPENDIX E
ENVIRONMENTAL PROGRAM REQUIREMENTS EXAMPLES

Report Date: 8/27/99

EXHIBIT 2 REPORT

HOOAH00001

Installation Name:	FORT HOOAH	FFID:	AL-211801C46	Major Command:	ARNG
Street Address:		Property Number:	01C46	Support Installation:	
City:	FT HOOAH	State:	ALABAMA	Country: US Zip:	
Congressional District:				Ownership Type:	
Abbreviation:	Example			Installation Type:	
Local Information:				Subcommand:	
ASG:		BSB:		Date of Last Revision:	8/27/99
Agency Project Number:	HOOAH00001	Multiple Installations:		Law/Reg Area:	SDWA
Project Name:	Compliance Evaluation - Stage 1 D/DBP and IESWTR			Environmental Category:	PDWS
Date of Initial Entry:	8/27/99			Compliance Status:	ESDF
Reason for Initiation:	HEALTH			Project Assessment:	H
P2 Category:				Class:	2
Pillar:	Compliance	Must Fund (Y/N):	Y	Design Plan Completion:	
Construction/Work Start:		Construction/Work Complete:		Final Compliance Required:	12/16/01
Progress Code:	PP			Year Funding Required:	
Project Contact Name:				Contact Telephone:	
Geographic Initiative:				Total Cost Estimate:	$ 40,000
Program Area:				Project Type:	
Other Project ID Type:				Other Project ID:	
Local Priority:				Command Priority:	

Fund Code: OMA(VENC) O&M ARMY (MDEP VENC)

FY	Budget Code	Required	Prg/Bdgt	Obligated
2000		$40,000	$0	$0

FY	Budget Code	Required	Prg/Bdgt	Obligated

Narrative:
This project is necessary to comply with recently finalized drinking water regulations. Based upon a review of water system filtered turbidity data and total trihalomethane (TTHM) monitoring data, the system may have difficulty complying with both the Stage 1 Disinfectants/Disinfectant Byproduct (Stage 1 D/DBP) Rule and the Interim Enhanced Surface Water Treatment Rule (IESWTR). This project will identify improvements required in water treatment to enable compliance with these two rules. Recommended upgrades will include cost estimations and associated Environmental Program Requirement (EPR) documentation.

Comments:
Cost for the project includes an in-depth, relevant water treatment onsite evaluation, and development of a comprehensive engineering report.

Report Date: 2/17/99

EXHIBIT 2 REPORT

GORDON0004

Installation Name:	FORT GORDON	FFID:	GA-213720368	Major Command:	TRADOC
Street Address:	ATZH-DIE	Property Number:	20368	Support Installation:	
City:	FORT GORDON	State:	GEORGIA	Country: US Zip:	30905
Congressional District:				Ownership Type:	GOCO
Abbreviation:				Installation Type:	
Local Information:				Subcommand:	
ASG:		BSB:		Date of Last Revision:	2/17/99
Agency Project Number:	GORDON0004	Multiple Installations:		Law/Reg Area:	SDWA
Project Name:	Drinking Water - Clearwell Upgrade			Environmental Category:	PDWS
Date of Initial Entry:	2/17/99			Compliance Status:	ESDF
Reason for Initiation:	ENVIR AUDIT			Project Assessment:	H
P2 Category:				Class:	2
Pillar:	Compliance	Must Fund (Y/N):	Y	Design Plan Completion:	
Construction/Work Start:		Construction/Work Complete:		Final Compliance Required:	12/17/01
Progress Code:	PP			Year Funding Required:	
Project Contact Name:				Contact Telephone:	
Geographic Initiative:				Total Cost Estimate:	$ 40,000
Program Area:				Project Type:	Construction
Other Project ID Type:				Other Project ID:	
Local Priority:				Command Priority:	

Fund Code: OMA(VENC) O&M ARMY (MDEP VENC)

FY	Budget Code	Required	Prg/Bdgt	Obligated
2000		$35,000	$0	$0

FY	Budget Code	Required	Prg/Bdgt	Obligated
2001		$5,000	$0	$0

Narrative:
Reference USACHPPM Report Water System Performance Evaluation Proj. No. 31-EC-8959-99. This project should be completed to comply with recently finalized drinking water regulations. Based upon a review of water system turbidity data and Total Trihalomethane (TTHM) monitoring data, the system may have difficulty complying with both the Stage I Disinfectants/Disinfectant Byproduct Rule and the Interim Enhanced Surface Water Treatment Rule. This project will allow for movement of the disinfection application point later in the process and a location for collection of a combined filter sample more representative of filtered water turbidity. This upgrade should result in a reduction in TTHMs and provide more reliable turbidity data. The project includes: 1) the construction of a common header that combines filtered water from each filter directly into the clearwell to increase contact time and decrease short ciruiting, 2) draining, sandblasting, cleaning, and disinfecting the clearwell after the modification, and 3) the conduct of a tracer study to be submitted for State approval to move the disinfection point from pre-filtration to post-filtration.

Comments:
Cost for the project includes $30,000 for the design and construction of the common header, $5,000 for draining, cleaning, sandblasting, and disinfecting the tank after the modification, and $5,000 to conduct the tracer study. The source of the cost information is an estimate from the contracted operator for the design and construction of the header and the tank cleaning and estimate for the tracer study based upon required manpower to conduct the study and prepare a short report.